

Kendriya Vidyalaya No. 3 Korba



Session 2023-24

Chemistry Investigatory Project

**Study of the Presence of Oxalate Ions in Guava
Fruit at Different Stages of Ripening**

Submitted to:
Mr. Bhaskar Dewangan
PGT Chemistry

Submitted by:
Arunima Singh
XII "A"

Certificate

It is certified that Arunima Singh, Reg. No.: B/2/24/19021/0001, of class XII “A” of Kendriya Vidyalaya No. 3 Korba has completed this project under the guidance and supervision of Mr. Bhaskar Dewangan with great diligence. The project for the subject of Chemistry titled “Study of the Presence of Oxalate Ions in Guava Fruit at Different Stages of Ripening” is up to the standards of the Central Board of Secondary Education and can be sent for evaluation.

Signature of Student

Signature of Teacher

Signature of External Examiner

Signature of Principal

Acknowledgement

I would like to express my special thanks to my chemistry teacher, Mr. Bhaskar Dewangan, who gave me the golden opportunity to do this wonderful project on the topic “Study of the Presence of Oxalate Ions in Guava Fruit at Different Stages of Ripening”, which helped me in learning a lot of new things.

Secondly I would also like to thank my parents and friends who helped me a lot in finalising this project within the limited time frame.

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Aim

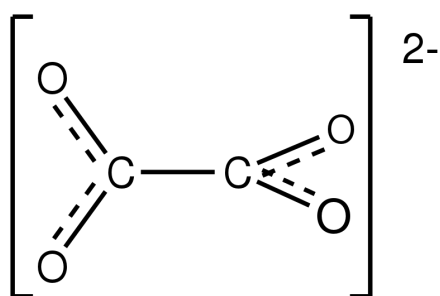
To Study of the Presence of Oxalate Ions in Guava Fruit at Different Stages of Ripening

Introduction

Guava is a common tropical fruit cultivated in many tropical and subtropical regions. The common guava *Psidium guajava* (lemon guava, apple guava) is a small tree in the myrtle family (Myrtaceae), native to Mexico, Central America, the Caribbean and northern South America. It is a rich source of oxalate and its content in the fruit varies during different stages of ripening.



Oxalate (IUPAC: ethanedioate) is an anion with the formula $\text{C}_2\text{O}_4^{2-}$. This dianion is colourless. It occurs naturally, including in some foods.



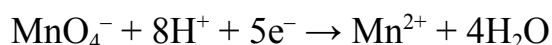
In this project, we will find the strength of oxalate ions in guava at different stages of ripening.

Theory

Oxalate ions are extracted from the fruit by boiling pulp with dilute H_2SO_4 . Then oxalate ions are estimated volumetrically by the solution with standard KMnO_4 solution.

Potassium permanganate is a strong oxidising agent and in the presence of sulfuric acid it acts as a powerful oxidising agent. In acidic medium the oxidising ability of KMnO_4 is represented by the following equation.

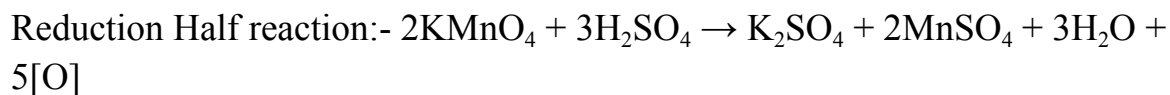
In acidic solution,



Solution containing MnO_4^- ions are purple in colour and the solution containing Mn^{2+} ions are colourless and hence the permanganate solution is decolourised when added to a solution of a reducing agent. The moment there is an excess of potassium permanganate present the solution becomes purple. Thus, KMnO_4 serves as a self indicator in acidic solution.

Potassium permanganate is standardized against pure oxalic acid. It involves a redox reaction. Oxalic acid is oxidised to carbon dioxide by KMnO_4 , which itself gets reduced to MnSO_4 . Oxalic acid reacts with potassium permanganate in the following way.

The chemical reaction at room temperature is given below.



The overall reaction takes place in the process is

Overall reaction:- $2\text{KMnO}_4 + 3\text{H}_2\text{SO}_4 + 5(\text{COOH})_2 \rightarrow \text{K}_2\text{SO}_4 + 2\text{MnSO}_4 + 8\text{H}_2\text{O} + 10\text{CO}_2\uparrow$

The ionic equation involved in the process is given below.

Reduction Half reaction:- $[\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}] \times 2$

Oxidation Half reaction:- $[\text{C}_2\text{O}_4^{2-} \rightarrow 2\text{CO}_2 + 2\text{e}^-] \times 5$

Overall Ionic reaction:- $2\text{MnO}_4^- + 16\text{H}^+ + 5\text{C}_2\text{O}_4^{2-} \rightarrow 2\text{Mn}^{2+} + 10\text{CO}_2 + 8\text{H}_2\text{O}$

This titration cannot be carried out in the presence of acids like nitric acid or hydrochloric acid because itself is an oxidising agent. So hydrochloric acid chemically reacts with KMnO_4 solution forming chlorine which is also an oxidising agent.

Materials Required

1. Potassium permanganate solution (N/10)



2. Dilute sulphuric acid



3. Weighing machine



4. Burette



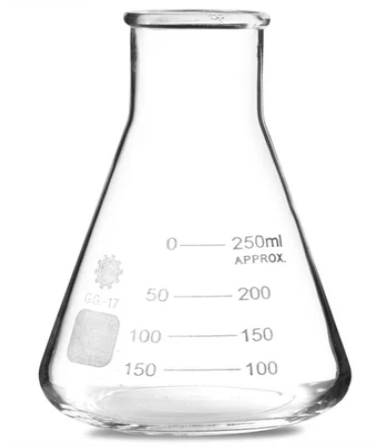
5. Burette stand



6. Pipette



7. Conical flask



8. Funnel



9. Measuring flask



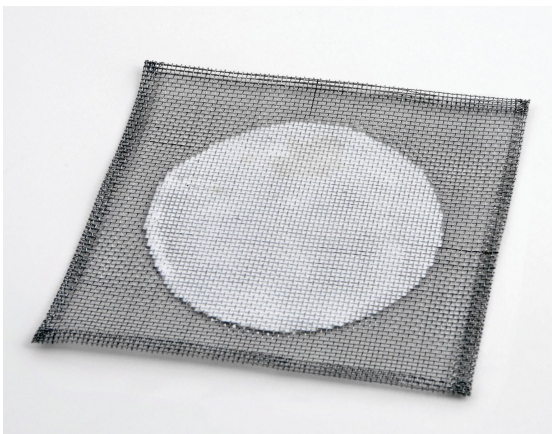
10. White tile



11. Burner



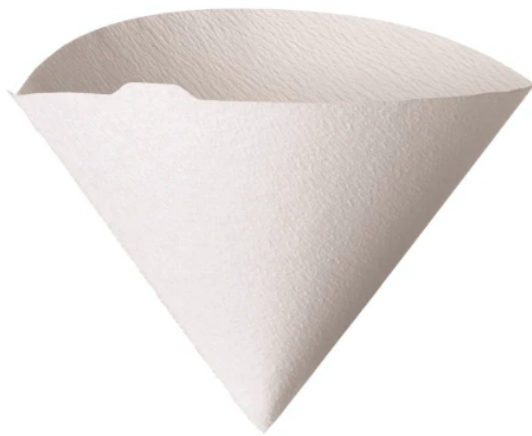
12. Wire gauze



13. Pestle and mortar



14. Filter paper



Procedure

1. Weigh 50 g of fresh guava and crush it to a fine pulp using pestle and mortar.
2. Transfer the crushed pulp to a beaker and add about 50 ml dilute H_2SO_4 to it.
3. Boil the content for about 10 minutes. Cool and filter the contents in a 100 ml measuring flask.
4. Make up the volume 100 ml by adding ample amounts of distilled water.
5. Take 20 ml of the solution from the flask and add 20 ml of dilute sulphuric acid to it.
6. Heat the mixture to about 60°C and titrate it against (N/10) KMnO_4 solution taken in a burette till the end point has an appearance of pink colour.
7. Repeat the above experiment with 50 g of 2 day and 3 day old guava fruits.

Observations

1. Weight of the guava fruit each time was 50 g.
2. Volume of guava extract taken for each titration was 10 ml.
3. Normality of KMnO_4 solution was (1/10).
4. End point : Colour changes to pink
- 5.

Guava Solution	Initial reading	Final Reading	Volume of KMnO_4
Raw	150	18	132
Semi-ripened	150	13	137
Ripened	150	10.8	139.2

Calculations

1. For raw guava,

$$N_1 V_1 = N_2 V_2$$

$$\Rightarrow N_1 \times 10 = (1 / 10) \times 132$$

$$\Rightarrow N_1 = 132 / 100 = 1.32$$

Strength of oxalate in fresh guava extract

= normality x Eq. mass of oxalate ion

$$= 1.32 / 100 \times 44 \text{ g / litre of diluted extract} = 0.581 \text{ g L}^{-1}$$

2. For semi-ripened guava,

$$N_1 V_1 = N_2 V_2$$

$$\Rightarrow N_1 \times 10 = (1 / 10) \times 137$$

$$\Rightarrow N_1 = 137 / 100 = 1.37$$

Strength of oxalate in one day old guava extract

$$= 1.37 / 100 \times 44 \text{ g / litre of diluted extract}$$

$$= 0.603 \text{ g L}^{-1}$$

3. For ripened guava,

$$N_1 V_1 = N_2 V_2$$

$$\Rightarrow N_1 \times 10 = (1 / 10) \times 139$$

$$\Rightarrow N_1 = 139 / 100 = 1.39$$

Strength of oxalate in ripened guava extract

$$= 1.39 / 100 \times 44 \text{ g / litre of diluted extract}$$

$$= 0.612 \text{ g L}^{-1}$$

Result

Normality of oxalate ion:

- Fresh guava solution = 1.32 N
- Semi - ripen guava solution = 1.37 N
- Ripened guava solution = 1.39 N

Strength of oxalate ion:

- Fresh guava solution is = 0.58 gL⁻¹
- Semi - ripen guava solution is = 0.60 gL⁻¹
- Ripened guava solution is = 0.61 gL⁻¹

Conclusion

- The content of oxalate ions in guava was found to be 59.67 percent, which is close to the literature value of 60 percent.
- It was also noticed that the content of oxalate ions grows with ripening of guava.

Precautions

1. There should be no parallax while taking measurements.
2. Spillage of chemicals should be checked.
3. Avoid the use of burette having a rubber tap as KMnO_4 attacks rubber.
4. In order to get some idea about the temperature of the solution touch the flask with the back side of your hand, when it becomes unbearable to touch the required temperature is reached.
5. Add about an equal volume of dil H_2SO_4 to the guava extract to be titrated (say a full test tube) before adding KMnO_4 .
6. Read the upper meniscus while taking burette reading with KMnO_4 solution.
7. In case, on addition of KMnO_4 , a brown ppt. appears, this shows that either H_2SO_4 has not been added or has been added in insufficient amount. In such a case, throw away the solution and titrate again.

Bibliography

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4. Navis, M. S., & Subila S. (2017, January). Study on the presence of oxalate ions in guava and sapota fruits. *International Journal of Advanced Science and Research*, 2(1), 15-17